

CALIBRATION STANDARD SPECIFICATION  
FOR AN  
ABSOLUTE PRESSURE DEADWEIGHT  
CALIBRATION SYSTEM  
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PROCUREMENT PACKAGE

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## CALIBRATION STANDARD SPECIFICATION FOR AN ABSOLUTE PRESSURE DEADWEIGHT CALIBRATION SYSTEM

### 1. SCOPE

1.1 Scope. This specification defines the mechanical, electrical, and electronic characteristics for an Absolute Pressure Deadweight Calibration System. This equipment is intended to be used by Navy personnel in shorebased and primary laboratories to calibrate and monitor vacuum measurements. For the purposes of this specification, the Absolute Pressure Deadweight Calibration System shall be referred to as the APDCS.

1.1.2 Absolute Pressure Deadweight System. The APDCS shall consist of the following individual components: A Dead Weight Tester (DWT); an Absolute Pressure Sensor (APS); a Capacitance Monitor Readout (CMR); a Variable Volume Pressure Controller (VVPC); two High Vacuum Pumps (HVP); and a Variable Area Pressure Controller (VAPC).

### 2. APPLICABLE DOCUMENTS

2.1 Controlling Specifications. MIL-T-28800, "Military Specification, Test Equipment for use with Electrical and Electronic Equipment, General Specification for," and all documents referenced therein of the issues in effect on the date of this solicitation shall form a part of this specification.

### 3. REQUIREMENTS

3.1 General. The APDCS shall conform to the Type II, Class 5, Style E requirements as specified in MIL-T-28800 for Navy shipboard and shorebased use as modified below. The use of material restricted for Navy use shall be governed by MIL-T-28800.

3.1.1 Design and Construction. The APDCS design and construction shall meet the requirements of MIL-T-28800 for Type II equipment.

3.1.2 Power Requirement. The APDCS shall operate from a source of 103.5V to 126.5V at 50 Hz and 60 Hz  $\pm$  5% single-phase input power as specified in MIL-T-28800.

3.1.2.1 Fuses or Circuit Breakers. Fuses or circuit breakers shall be provided. If circuit breakers are used, both sides of the power source shall be automatically disconnected from the equipment in the event of excessive current. If fuses are used, only the line side of the input power line, as defined by MIL-C-28777, shall be fused. Fuses or circuit breakers shall be readily accessible.

3.1.2.2 Power Connection. The APDCS shall have an interface cable for capability of remote sensing.

3.1.3 Dimensions and Weight. Maximum dimensions and weights of individual APDCS components is contained in Section 3.5. The APDCS total weight shall not exceed XXX pounds.

3.1.4 Lithium Batteries. Per MIL-T-28800, lithium batteries are prohibited without prior authorization. A request for approval for the use of lithium batteries, including those encapsulated in integrated circuits, shall be submitted to the procuring activity at the time of submission of proposals. Approval shall apply only to the specific model proposed.

3.2 Environmental Requirements. The APDCS shall meet the environmental requirements for a Type II, Class 5, Style E equipment with the deviations specified below.

3.2.1 Temperature and Humidity. The APDCS shall meet the conditions below:

Temperature (°C) Relative Humidity (%)

|               |           |                |
|---------------|-----------|----------------|
| Operating     | 10 to 30  | 95             |
|               | 30 to 40  | 75             |
| Non-operating | -40 to 70 | Not Controlled |

3.2.2 Electromagnetic Compatibility. The electromagnetic compatibility requirements of MIL-T-28800 are limited to the following areas: CE01, CE03, CS01, CS02, CS06, RE01, RE02 (14 kHz to 1 GHz), and RS03.

3.3 Reliability. Type II reliability requirements are as specified in MIL-T-28800.

3.3.1 Calibration Interval. The APDCS shall have an 85% or greater probability of remaining within tolerances of all specifications at the end of a 12 month period.

3.4 Maintainability. The APDCS shall meet the Type II maintainability requirements as specified in MIL-T-28800 except the lowest discrete component shall be defined as a replaceable assembly. Certification time shall not exceed 60 minutes.

3.5 Performance Requirements. The APDCS shall provide the following capability as specified below. Unless otherwise indicated, all specifications shall be met following a 30-minute warm-up period.

3.5 TABLE OR SYSTEM (REMINDER TO ADD SECTION)

3.5.1 Dead Weight Tester Requirements.

3.5.2 Absolute Pressure Sensor Requirements. The APDCS shall have an Absolute Pressure Sensor (APS) that meets the following requirements.

3.5.2.1 Pressure Range. The APS shall have a minimum full scale pressure range up to 100 mmHg.

3.5.2.2 Resolution. The APS shall have a minimum resolution of  $1 \times 10^{-6}$  full scale.

3.5.2.3 Accuracy. The APS shall have an accuracy of at least  $\pm 0.05\%$  of reading  $\pm$  the temperature coefficient.

3.5.2.4 Useable Measurement Range. The APS shall have a useable measurement range of at least  $1 \times 10^{-5}$  of full scale.

3.5.2.5 Zero Temperature Coefficient. The APS shall have a maximum zero temperature coefficient of 4 ppm full scale per °C.

3.5.2.6 Span Temperature Coefficient. The APS shall have a maximum span temperature coefficient of 20 ppm (R/°C).

3.5.2.7 Volume. The APS shall have a nominal volume of 2.5 cc  $\pm$  1.0 cc.

3.5.2.8 Pressure. The APS shall be able to withstand an over-pressure of at least 34 psia.

3.5.2.9 Time Response. The APS shall have a time response of less than 25 msec.

3.5.2.10 APS Operating Requirements. The APS shall provide the following capabilities.

3.5.2.10.1 Materials. The APS material exposed to gases shall be stainless steel.

3.5.2.10.2 Pressure Fittings. The APS shall have pressure fittings of Cajon 4-VCR; male or female as specified.

3.5.2.10.3 Vibration Isolation. The APS shall have vibration isolation.

3.5.2.10.4 Internal Environmental Control. The APS shall require an internal environmental control above ambient temperature with thermal transpiration effecting reading of less than 4%.

3.5.2.11 Compatibility Requirements. The APS shall be compatible with all APDCS components listed in paragraph 1.1.2 as applicable.

3.5.3 Capacitance Manometer Readout Requirements. The APDCS shall have a capacitance manometer readout (CMR) that meets the following requirements.

3.5.3.1 Ranges. The CMR shall have ranges of x1, x0.1, x0.01 of sensor Full Scale.

3.5.3.2 Analog Output Range. The CMR analog output range shall be  $0 \pm 10$  VDC on each range, into greater than 10K ohm load.

3.5.3.3 Output Impedance. The CMR output impedance shall be less than 1 ohm.

3.5.3.4 Output Linearity. The CMR output linearity shall be a minimum of  $\pm$  (0.005% Reading +0.001% Full Scale).

3.5.3.5 Output Noise. The CMR shall have a maximum output noise of 70 mVolts at 0.4 Hz bandwidth. The APDCS shall have a maximum output noise of 4 mVolts peak-to-peak in the range of 1kHz to 1 Mhz.

3.5.3.6 Output Zero Drive. The CMR output zero drift shall be less than 0.05 mVolts/°C.

3.5.3.7 BCD Output. The CMR shall have a BCD output of parallel line 3-state logic; decimal point and range ID are buffered TTL levels; all outputs can drive one TTL load.

3.5.3.8 Units Selection Switch. The CMR shall have a unit selection switch for displaying pressure in mmHg, millibars, kilopascal, In Hg, cmH<sub>2</sub>O or psi In H<sub>2</sub>O.

3.5.3.9 CMR Operating Requirements. The CMR shall provide the following capabilities.

3.5.3.9.1 Display. The CMR shall have a display of 5-1/2 digits.

3.5.3.9.1.1 Display Accuracy. The CMR shall have a display accuracy of  $\pm 0.001\%$  reading  $\pm 1$  count.

3.5.3.9.1.2 Display Update Rate. The CMR shall provide an update rate of at least 1 reading per second.

3.5.3.10 Compatibility Requirements. The CMR shall be compatible with all APDCS components listed in paragraph 1.1.2 as applicable.

3.5.3.10.1 Sensor Compatibility. The CMR shall be compatible with the Baraton 600 series sensors.

3.5.4 Variable Volume Pressure Controller Requirements. The APDCS shall have a variable volume pressure controller (VVPC) that meets the following requirements.

3.5.4.1 Pressure Range. The VVPC shall have a minimum pressure range of 0 to 1,000 psi.

3.5.4.2 Adjustment Sensitivity. The VVPC shall have an adjustment sensitivity of at least  $\pm 0.0005$  psi.

3.5.4.3 Leak Rate. The VVPC shall have a leak rate of less than  $1 \times 10^{-5}$  atm cc/sec.

3.5.4.4 Total Mechanical Rotation. The VVPC shall have a minimum total mechanical rotation of 33 1/2 turns.

3.5.4.5 Temperature Range. The VVPC shall have a minimum temperature range of 32°F to 120°F (0 to 49°C).

3.5.4.6 VVPC Operating Requirements. The VVPC shall provide the following capabilities.

3.5.4.6.1 Pneumatic Pressure Generation. The VVPC shall be able to generate a minimum pneumatic pressure of 35 psia.

3.5.4.6.2 Proof Pressure. The VVPC shall have a minimum proof pressure of 2,000 psi.

3.5.4.6.3 Construction. The VVPC construction shall meet the following requirements.

3.5.4.6.3.1 Aluminum Body. The VVPC shall have an aluminum body.

3.5.4.6.3.2 Stainless Steel Screw and Valve Stem. The VVPC shall have a stainless steel screw and valve stem.

3.5.4.6.4 Life. The VVPC shall have a minimum life of 250,000 cycles.

3.5.4.6.5 Total Volume. The VVPC shall have a total volume of 12.5 cubic inches  $\pm$  0.5 cubic inches.

3.5.4.7 Compatibility Requirements. The VVPC shall be compatible with all APDCS components listed in paragraph 1.1.2 as applicable.

3.5.5 AutoPrompt Converter. The APDCS shall have an AutoPrompt Converter (APC) that meets the following requirements.

3.5.5.1 Measurement Range. The APC shall meet the following measurement ranges.

3.5.5.1.1 Temperature Measurement Range. The APC shall have a minimum temperature measurement range of 15 to 30°C (59 to 86°F).



3.5.5.1.2 Float Position Indicator Range. The APC shall have a minimum float position indicator range of  $\pm 0.200$  in. at a midfloat reference of 0.000 in.

3.5.5.2 Reference Pressure. The APCs reference pressure shall be user selectable between absolute or gage.

3.5.5.3 Data Set Retention. The APC shall meet the following data set retention requirements.

3.5.5.3.1 Piston/Cylinder Assemblies. The APC shall store at least six different piston/cylinder assemblies.

3.5.5.3.2 Mass Sets. The APC shall store at least two different mass sets of up to 32 masses each.

3.5.5.4 Operating Requirements. The APC shall provide the following capabilities.

3.5.5.4.1 Memory Retention. The APC's RAM shall be backed up by a battery source.

3.5.5.4.2 Display. The APC shall have a display with a minimum of 4 lines x 40 characters per line.

3.5.5.4.3 Pressure Units. The APC shall display the following pressure units: psi, psf, Mpa, kPa, kg/cm<sup>2</sup>, mm Hg (0°C), in. Hg (0°C), mm H<sub>2</sub>O (4°C), cm H<sub>2</sub>O (4°C), in. H<sub>2</sub>O (4°C), mb. atm, altitude (geopotential ft) and calibrated air speed (knots).

3.5.5.5 Keyboard. The APC shall have a Membrane, 4x6 matrix keyboard to input information.

3.5.5.6 Printer Output. The APC shall have a printer output as follows: RS-232; baud rates; 110, 300, 600, 1200, 2400, 4800, 9600; odd, even or no parity; 7 or 8 data bits, 1 or 2 stop bits; busy hardware handshake on RS-232 pin 5 (CTS).

3.5.5.7 Compatibility Requirements. The APC shall be compatible with all APDCS components listed in paragraph 1.1.2 as applicable.

3.5.6 High Vacuum Pump Requirements. The APDCS shall have two high vacuum pumps (HVP) that meet the following requirements. For purposes of this specification the two HVPs are referred to as high vacuum pump 1 (HVP1) and high vacuum pump 2 (HVP2).

3.5.6.1 Free Air Displacement. The HVP1 shall provide a minimum free air displacement of up to 50 liters per Minute (1.8 CFM) at 60 Hz.

3.5.6.2 Pressure. The HVP1 shall meet the following pressure requirements.

3.5.6.2.1 Guaranteed Ultimate Pressure. The HVP1 shall provide a guaranteed ultimate pressure of up to  $6.0 \times 10^{-4}$  Torr (0.0006mm Hg).

3.5.6.2.2 Ultimate Pressure. The HVP1 shall provide an ultimate pressure of up to  $7.0 \times 10^{-3}$  Torr (0.007 mm Hg).

3.5.6.3 Motor/Pump. The HVP1 shall have a motor/pump that satisfies the following requirements.

3.5.6.3.1 Pump Speed. The HVP1 shall provide a pump speed of up to 1725 rpm at 60 Hz (1425 rpm at 50 Hz).

3.5.6.3.2 Horsepower. The HVP1 shall have a minimum horsepower of 1/3 hp.

3.5.6.4 Operating Requirements. The HVP1 shall provide the following capabilities.

3.5.6.4.1 Connections. The HVP1 connections shall meet the following requirements.

3.5.6.4.1.1 Intake/Exhaust. The HVP1 intake/exhaust connection shall be ISO NW25.

3.5.6.4.2 Design. The HVP1 shall have a two stage design.

3.5.6.4.3 Ballast. The HVP1 shall have a gas ballast.

3.5.6.4.4 Valves. The HVP1 shall have an antisuckback valve. The APDCS shall have an isolation valve.

3.5.6.5 Compatibility Requirements. The HVP1 shall be compatible with all APDCS components listed in paragraph 1.1.2 as applicable.

3.5.7 The APDCS shall have a HVP2 that meets the following requirements.

3.5.7.1 Free Air Displacement. The HVP2 shall provide a minimum free air displacement of up to 160 liters per Minute (5.6 CFM) at 60 Hz.

3.5.7.2 Pressure. The HVP2 shall meet the following pressure requirements.

3.5.7.2.1 Guaranteed Ultimate Pressure. The HVP2 shall provide a guaranteed ultimate pressure of up to  $1.0 \times 10^{-4}$  Torr (0.0001mm Hg).

3.5.7.2.2 Ultimate Pressure. The HVP2 shall provide an ultimate pressure of up to  $3.0 \times 10^{-3}$  Torr.

3.5.7.3 Pump. The HVP2 shall have a pump that satisfies the following requirements.

3.5.7.3.1 Pump Speed. The HVP2 shall provide a pump speed of up to 525 rpm.

3.5.7.3.2 Motor. The HVP2 shall have a motor that satisfies the following requirements.

3.5.7.3.2.1 Motor Speed. The HVP2 shall have a motor speed of 1725 rpm at 60 Hz (1425 rpm at 50 Hz).

3.5.7.3.2.2 Horsepower. The HVP2 shall have a minimum horsepower of 1/2 hp.

3.5.7.4 HVP2 Operating Requirements. The HVP2 shall provide the following capabilities.

3.5.7.4.1 Drive. The HVP2 shall have a V-Belt drive.

3.5.7.4.2 Connections. The HVP2 connections shall meet the following requirements.

3.5.7.4.2.1 Intake. The HVP2 intake connection shall have a nipple thread type, 1-20 3/4 inch ID (19mm).

3.5.7.4.2.2 Exhaust. The HVP2 exhaust connection shall have a thread type, 1-20.

3.5.7.5 Compatibility Requirements. The HVP2 shall be compatible with all APDCS components listed in paragraph 1.1.2 as applicable.

3.7 Manual. At least two copies of an operation and maintenance manual shall be provided. The manual shall meet the requirements of MIL-M-7298.

3.7.1 Calibration Procedure. A calibration procedure in accordance with MIL-M-38793 shall be provided.